ISS PAYLOADS NEWS

May 2004
Volume 3, Issue 1

Customer Service Hot Line: 281-244-6187

High Schools Manufacture Training Hardware for NASA Payloads

By Stacy Hale & Bob Zeek

The HUNCH logo represents the students taking the raw material and molding it and conforming it into something crisp, smooth and precise for NASA to use.

During the summer of 2003 Stacy Hale/DV4 from Johnson Space Center spent three months at Marshall Space Flight Center (MSFC) working for Debbie Underwood/FD35. Debbie teamed Stacy with Bob Zeek/FD35 to improve the training laboratory mockup at MSFC in building 4610. The lab mockup consisted of an Express Rack Trainer and pictures to represent the U.S. Lab. Payloads training for ground support personnel consisted of reading documentation and classroom instruction. There was very little, if any, hands-on training hardware.

Faced with this limitation Stacy came up with a unique solution, later to be named HUNCH (High school students United with NASA to Create Hardware). The solution was inspired by his son's Bar-B-Q pit that he built in high school. The solution was to team with high schools that had the capability and desire to work with NASA. NASA would provide the materials and the documentation. The schools would provide the technical direction to the students and a safe working environment.

Debbie felt the idea had merit, and Greg Burns/FD35 was added to the team to start working with the MSFC/Education Outreach.

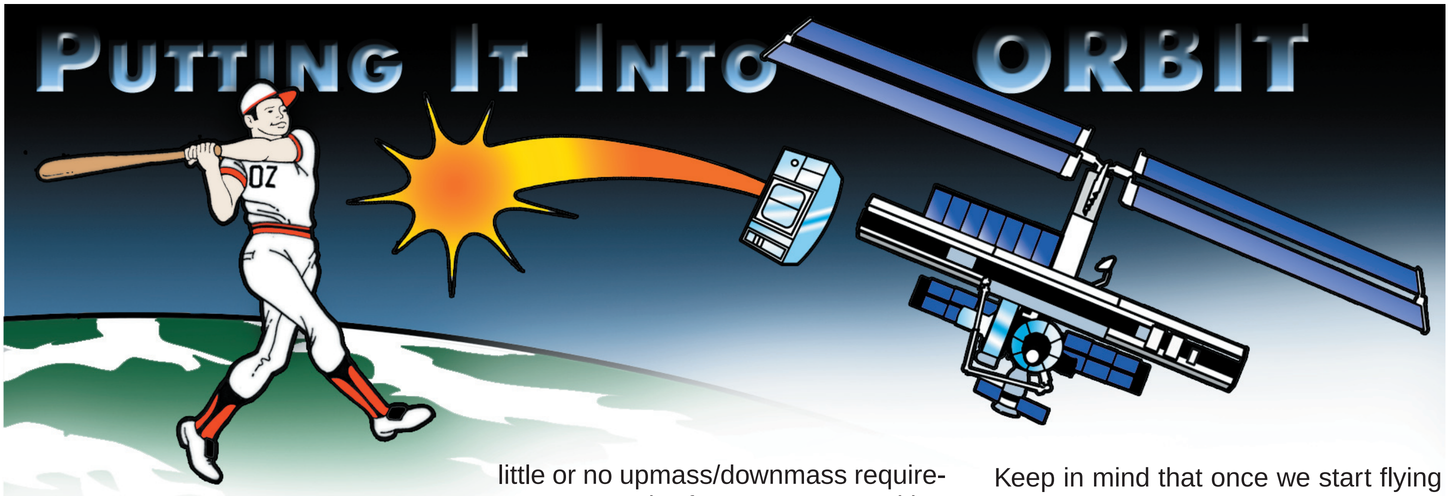
The HUNCH team put together a phased approach to meet the goal of fabricating integratable and standalone payload training simulators. Because of the shortage of subrack payloads, and the fact that most subrack payloads are based on an ISS Single Stowage Locker, it was decided that the first phase would be the fabrication of ISS Single Stowage Lockers. To make Phase One successful, schools were needed that could perform metal fabrication. The second phase would be the mockup of two to three subrack payloads. This will also require metal fabrication. Also, Phase Two will include the addition of electronics. Specifically, a school will be sought that can develop wiring, programming and control input/output devices. Phase three is the merger of the mockup with the electronics to produce a simulator, either standalone or integrated. When all phases are finished and there are high schools teamed with NASA, HUNCH will be an option that can be offered to Payload Developers for the fabrication of a training unit.

Other phases were defined to represent the fabrication of other items. These items included international standard payload rack (ISPR) training racks and the outfitting of those racks; soft stowage, like cargo transfer bags; and training modules, like the Centrifuge

*(see **HUNCH**, page 4)*

Clear Creek High School HUNCH Team operates a metal break and a drill press during the fabrication of payload locker mockups for NASA crew training.

What's Inside



One of my most pleasant tasks in executing this office is the recognition of teammates who have distinguished themselves. This is made even more enjoyable because we work with so many extraordinary people. We have recently held awards presentations at JSC, MSFC and KSC during which Kathy and I presented more than 50 awards to teammates who have demonstrated excellence in performing their jobs. I wish I had room here to list what each of you has done but, fortunately, there are too many of you. Thanks again; you make us all proud.

Now is a busy time for research integration on ISS. The principal contributors to the current rush are the alignment of our activities with the "Vision for Space Exploration" and the development of the FY05 budget.

A prime tenet of the exploration initiative is the retirement of the Space Shuttle in 2010. This new planning constraint comes just as Shuttle is planning for return to flight (RTF). To the research community, loss of the Shuttle means loss of the only transportation system that provides power during launch-to-orbit for payloads that require environmental conditioning (i.e., temperature maintenance, periodic mixing, etc.). The Shuttle is also the only current vehicle that affords research a significant sample return capability. This has been a severe constraint to the selection of research since the *Columbia* accident, and a meaningful ISS research program has been sustained only through the dedicated efforts of several very bright people who have sought out significant scientific research that is peer-reviewed and ready to fly with little or no upmass/downmass requirements. For the future, we are making sure that research requirements are included in planning transportation for the post-Shuttle era.

Though we continue to fight for any upmass possible on the Russian launch vehicles, the real potential for robust utilization of ISS is tied to the Shuttle. Beyond a safe Shuttle RTF in early 2005, much of our focus is on expanding the capabilities of the ISS laboratories. The first Shuttle manifest will include the second Human Research Facility rack. The second flight will launch two more facility class payloads; the European Modular Cultivation System and the Minus 80° Laboratory Freezer for ISS. Each flight will also carry multiple subrack payloads and logistics support for existing onboard research.

The ISS Program is looking at options of increasing the crew size from 3 to 6 earlier than planned. Moving to a full crew of six is a priority. This provides more crew time for research support and more subjects for Bioastronautics, but it requires more crew logistics and an advanced environmental control and life support system (ECLSS) located in the Destiny Laboratory.

The impact on lab volume and the Moderate Temperature Loop cooling water resource would limit the research operations within Destiny, but we have 10 ISPR spaces in the IP modules.

In support of Shuttle RTF, our integration planning for LF-1 and ULF1.1 is maturing. KSC testing of manifested, rack-level payloads will begin later this year. Everyone is being meticulous in flight preparation, because we expect the Certification of Flight Readiness process to be very closely scrutinized.

Keep in mind that once we start flying Shuttles again, it won't be long before the IP modules are added to the ISS. We have begun working with the European Space Agency to insure that our integration processes and organizations will interface smoothly. This is critical to enable an integrated timeline on board as well as for sharing research volume in the multiple laboratories.

Plans are to integrate and checkout the HRF-FPR rack in Bremen, Germany with the flight Columbus Module. An end-to-end, MPLM test with the orbiter simulator, flight MPLM and a flight MELFI is also scheduled later this year. Plans are being developed to support an AMS ground test at KSC for its orbiter and station interfaces.

We are heavily involved in the NASA budget development cycle at present. Budget cuts look likely … and that may impact research throughput. We are striving to guarantee a posture in which what we must do can be done correctly.

The Payloads Office is continuing to improve our processes and our interfaces with investigators. Phase I of the ISS Downlink Enhancement Architecture Project was successfully completed, and we are now positioned to implement Phase II, which will effectively triple the downlink data rate. With the help of the Station Program Scientist Office, more direct interaction has been arranged between the principal investigators and the onboard crew. The impending major revision of the Payload Data Library software will improve the usability and eliminate data redundancy in the input. With your help, we will realize an effecient organization to integrate and operate your payloads oboard the ISS.

Advanced Diantostic Ultrasound in Microgravity (ADUM)

By Don Thomas

Flight crew learns ultrasound procedures during ground testing.

The odds of a serious illness in populations similar to U.S. astronauts (i.e., nuclear submarine crews, Antarctic residents and space station Mir crew) are roughly 6% per person per year. Given these odds, there is a significant probability that an ISS crew member will become ill or injured over the projected life of the ISS. Because of the enormous conse-quences of performing a medical evacuation from the ISS, any tool that can be used to more accurately diagnose and assess a crew member's condition needs to be evaluated.

Currently, the only medical imaging device on the ISS is the Human Research Facility ultrasound system. Of the 500 or so medical conditions thought to be of potential concern to crew members of the ISS, ultrasound can play a role in the diagnosis of at least 250 of these. But while ultrasound can be an extremely useful diagnostic tool, it has the drawback of being highly operator dependent, requiring many hours of hands-on training for operators to be truly proficient and skilled. Because the number of hours available for training long-duration crew members heading to the ISS is severely limited, the potential use of the ISS ultrasound device for various medical research projects or for on-orbit diagnosis has been limited to date.

<u>Experiment Concept</u>

To get around the issue of limited crew training time, a creative group of folks came up with the idea of remotely training the crew (on-orbit training) and of performing the ultrasound investigations aboard the ISS in a "telemedicine" fashion. The concept is that after receiving the onboard training, crew members could become ultrasound operators, their hands directed real time by a skilled specialist sitting hundreds if not thousands of miles away in the Mission Control Center in Houston, Texas, or at some other remote Telescience Support Center (TSC) located elsewhere on the planet. This concept of onboard training together with the development of telemedicine assistance or remote guidance from highly skilled ultrasound specialists on the ground has the potential for opening the door for more sophisticated human research and medical diagnostic capability than is currently available.

<u>ISS Flight Experience</u>

This concept was first explored on September 13, 2002, during Expedition 5 with Science Officer Peggy Whitson as the onboard operator. During this Expedition 5 session, she was guided through multiple clinical scanning protocols adapted for the microgravity environment and the specific settings of a remotely guided self-examination. Peggy was able to perform an evaluation of three different ultrasound probes and transmitted real-time video from the ultrasound to the ground for the first time. Techniques were also evaluated for conducting a two-person ultrasound exam using the onboard crew medical restraint system.

Techniques were further refined during the second session in March 2003 with the ISS-6 crew members Ken Bowersox and Don Pettit. Each crewmember performed a real-time cardiac scan of the other crew member under the direction of a registered diagnostic cardiac sonographer. These tests proved extremely successful, and clinicians from Baylor College of Medicine with expertise in cardiology and echocardiography concluded the obtained scans were clinically adequate for a majority of acute cardiac candidates possible on ISS.

Two additional studies have continued on Expedition 7. During the first session, an ultrasound expert in the TSC in Houston guided crew member Ed Lu through capturing specific clinical images with anatomical details on himself. Digital images were recorded on board and were later compared with the downloaded images. Initial image comparisons have shown very minimal degradation of the image during the real-time downlink process.

A second series of runs was conducted by Expedition 7 crew members Ed Lu and Yuri Malenchenko in September 2003. These tests involved guiding one crew member through real-time cardiac scanning on a second crew member while resting on the cycle ergometer, then while pedaling at slow, medium, and fast rates demonstrating that clinically valid and interpretable stress (exercises) echocardiography data with a minimally trained and

(See **ULTRASOUND***, page 5)*

HUNCH

(continued from page 1)

Accommodation Module (CAM), in the Space Station Training Facility.

A successful HUNCH can lead to high school manufacturing trailers that represent different ISS modules. The trailers would be cylindrical on the outside, but on the inside would be a full-scale mockup of an ISS module's living space. The inside would have pictures on the floor and ceiling, but the sides would be six-inch-deep racks that represent the racks on orbit. The racks would be built by different schools around the USA in a NASA "build-a-rack" competition. The best racks would be mounted into a trailer then the trailers will be sent to schools and fairs around the USA to educate the population about what it is like onboard the ISS.

Prior to Stacy returning to JSC, the HUNCH team put together a Phase One project plan that was presented to and approved by Rickey Cissom/POIF.

Phase One; The Manufacture of 30 ISS Single Stowage Lockers.

Stacy, Bob and Greg began looking for high schools that had the capabilities and would be interested in teaming with NASA. Stacy found Clear Creek High School (CCHS) in League City, Texas. Bob found Brewer High School (BHS) in Huntsville, Alabama. And Greg found Huntsville Center for Technology (HCT) in Huntsville, Alabama.

Each school has its specialty and will contribute differently to the Phase One goals. CCHS has tremendous eagerness to work with NASA and has basic metal cutting, drilling and bending capabilities. The shop teacher Mr. Gibbs also has experience in organizing assembly line production. Therefore, CCHS was chosen to cut, drill and bend all sheet metal activities and provide the assembly of all pieces. CCHS will build the locker top, bottom and sides. BHS always performs well at state-level welding competitions. Therefore, BHS is to weld the corners of the box to increase its rigidity and to weld together items to create locker insertion tools. HCT is an incredible find. It has drafting, painting, programming, electronics and metal fabrication machinery. Therefore, HCT will be used to cut out the door and back plate. They will also paint the door.

HCT Students setting up their milling machine. with tooling and clamp blockks

Process: The first activity is to demonstrate the capability of each school by building a prototype. Because there are three schools involved in the manufacturing, there are dependencies that must be worked out prior to getting into production. CCHS built prototype #1. It turned out to be too big and would not fit on the back plate of an old training unit. But this did prove that CCHS could be successful; they just needed to make some minor modifications to a drilling template. CCHS built prototype #2. The size was good, but the box was not square. It was decided that using an assembly jig to keep the sides square would fix this problem. It was also decided that a pneumatic rivet gun should be used to maintain consistent riveting. The prototype #2 was sent to BHS. BHS was able to weld the corners of prototype #2. This minimizes sharp edges and stiffens the locker structure. BHS was also able to manufacture a locker insertion tool. With these two items demonstrated, BHS is ready to go into production.

Prototype #2 was next taken to HCT. HCT resolved real project problems with the software load in their computer-controlled lathe and with the hardware operation before cutting out the first door to be mounted onto prototype #2. HCT also finished back plate drawings, but has not yet cut out a back plate. Based on what NASA observed from HCT, no problem is expected with their manufacture of the door and the back plate. So, all schools have shown that they are able to perform their part of the fabrication.

Current status: CCHS has finished their part of fabricating the 30 lockers. BHS and HCT willfinish their part in the fall semester of next school year. One locker has been finished and that locker was presented to ISS Program Manager Bill Gerstenmaier at a HUNCH Reception sponsored by CCHS on May 11, 2004.

Production: CCHS will start the production by manufacturing 30 boxes that have top, bottom, sides, door latch ears, and locker insertion tool guides. These boxes will then be shipped to BHS. BHS will weld the corners. The boxes are then shipped to HCT where the back plate is mounted. The back plate will have the MILSON fasteners already attached. HCT will also manufacture the hinge/door assembly for the box. The door will be painted and have the closeout panels installed. HCT will also provide a rear-breather closeout. HCT will install the door assemble and latches and perform a quality inspection to make sure there are no sharp edges or burs. All sharp edges and burs will be filed smooth. The boxes will now be ISS single stowage lockers that support rear-breathing ventilation.

HCT Instructor and student discuss locker door hinge options with NASA.

High Toxicity Causes High Anxiety on Space Station

By Tim Smith

A working group was formed at the request of the ISS Program Manager to review ISS policy on the use of Toxic Hazard Level (THL) 4 substances on ISS. This review also encompasses the engineering and operations re-quire-ments associated with the use of THL 4 substances on ISS. Working group membership includes safety review panel members, operations personnel, toxicologists, flight surgeons, ISS environmental control life support systems (ECLSS) representatives, and payload utilization personnel. The primary objective of this working group has been to determine if the existing ISS Program containment/operational response policy on toxic substances in the habitable environment on ISS is adequate.

The working group has been meeting on a regular basis since January 2004. The discussions and topics addressed have been far-ranging, but the following list of questions summarizes the primary areas of emphasis:

- Should any substances be banned from the ISS habitable environment?
- Are the assumptions used in the toxicity assessment communicated and understood by the Safety and Operations Organizations?
- How do the Safety Review Panels ensure adequate oversight/verification of the payload hardware provider during fabrication of containment for extremely toxic substances?
- What is the process for ISS Management notification of the presence of THL 4 substances?
- What are the existing detection capabilities on the ISS?
- What detection capabilities should be provided (by payloads or ISS Systems)?
- Loss of containment detection?
- Detection of the toxic substance?
- Do lithium thionyl chloride batteries (generally THL 4) require additional hazard controls?
- Should damage to ECLSS hardware be a factor in the substance assessment that drives containment/operational response?

•Are the existing “loss of containment” response procedures adequate?

•What is the policy on the use of ISS personal protection equipment consumables by a payload?

A “heads up” letter emphasizing NASA’s heightened level of concern with the use of THL 4 substances in habitable spacecraft environments has been drafted by the working roup has been distributed to the general payload community by the PSRP Executive Secretary.. If you have questions about the Tox 4 Working Group, contact Tim Smith 256-544-4358.

Ultrasound

(continued from page 3)

an untrained operator using remote real-time guidance can be performed successfully. Additional development of these techniques has leld to the Advanced Diagnostic Ultrasound in Microgravity (ADUM) project currently scheduled to continue during Increments 8, 9, and 10.

Training the crew members in operating the ultrasound and obtaining high-quality images remains one of the greatest challenges of this project. To meet these needs, an “Onboard Proficiency Enhancer” nicknamed OPE (pronounced Opie) was developed by a joint team of researchers. This program was devel-oped for use on any available laptop computer aboard ISS and requires one hour of training once the crew is on orbit. Far from a dry or purely instruc-tional program, it has evolved into a lively if not entertaining instruction aid that the developers are hoping will actually be enjoyable for the astronauts.

Ultrasound investigations of the human body previously unattainable because of the great number of training hours required may become possible in the future through this unique combination of computer-based training (CBT) and telemedicine.

During the initial trials, the concept is proving itself nicely.

<u>Earth-Based Applications</u>

From the initial concept of using ultrasound for medical diagnosis aboard orbiting spacecraft (NASA’s unique initial requirement was to monitor a collapsed lung condition), its utility has been spreading in recent years. Use of ultrasound for assessing collapsed lungs has become a terrestrial standard, and more and more emergency medical technician crews and air ambulances are using this technique today. This technique has also become a standard diagnostic tool with armed forces medical corps where ultrasound assessments of collapsed lungs have been performed routinely the past few years in Afghanistan and, more recently, in Iraq.

Besides the use of ultrasound imaging to assess collapsed lung conditions, this NASA research has other Earth-based applications. The CBT program developed for our ISS crews is also seeing widespread use for training medical students across the country. Over 50,000 students of the American College of Surgeons each year receive this training as part of an advanced module on trauma care.

Not only of potential benefit to NASA researchers and those responsible for taking care of our crews on ISS, this technique has enormous potential here on Earth for performing medical diagnoses from isolated bases in Antarctica to remote rural communities across the United States that may not have ready access to a highly skilled ultrasound operator or ultrasound specialist. Using this scheme of minimal training with real-time remote driven telemedicine, this technique has enormous potential impact and could contribute to lowering of health care costs by eliminating the need to transport the patient to an ultrasound diagnostic specialist.

Expeditio

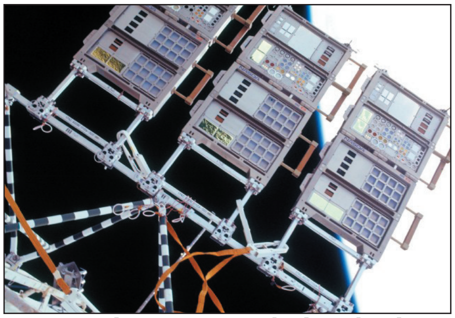
By John Uri

It has been an eventful time since the last ISS Payloads Office Newsletter was published in November 2003. President Bush announced his Exploration Vision in January, the NASA Space Flight Leadership Council in February decided to delay the Shuttle's return to flight from September 2004 to March 2005, the Expedition 8 crew completed its six-month mission and performed a precedent-setting spacewalk. The Expedition 9 crew complement was changed not once, but twice, before they began their six-month mission, and we remembered the *Columbia* crew on the one-year anniversary of the tragic accident.

On January 14, 2004, President George W. Bush announced his Vision of Space Exploration at NASA Headquarters, setting the Agency's goals to: return the Space Shuttle to flight as soon as safely possible; finish construction of International Space Station; retire the Space Shuttle fleet by 2010; develop the Crew Exploration Vehicle to enable human missions to the Moon between 2015 and 2020; and prepare for voyages of exploration to Mars thereafter. U.S. research aboard ISS would be redirected to support the goals of the Exploration Vision. Since the announcement, work has been under way to address the reprioritization of currently planned ISS research, as well as to develop an ISS assembly sequence that, to be consistent with the Presidential Directive, is limited to no more than 30 Shuttle flights plus Partner launch vehicles. It is anticipated that the work will be complete by summer 2004.

On February 19, 2004, the NASA Space Flight Leadership Council met to review the status of activities related to returning the Space Shuttle to flight. Primarily due to issues related to the recertification of the External Tank for safe flight and absolute minimum shedding of foam, the Council decided to delay the launch of the first Shuttle flight, designated LF-1, from September 2004 to no earlier than March 6, 2005. The delay means that the U.S. research program will be relying on Russian Progress and Soyuz vehicles for limited transport of hardware and samples for an additional six months.

The Expedition 8 crew of ISS Commander and NASA Science Office Mike Foale and Russian Flight Engineer Alexander Kaleri was kept busy conducting a number of U.S., Russian, Japanese and European experiments while maintaining the vehicle's systems. On February 26, Foale and Kaleri performed the first extravehicular activity (EVA), or space walk, in ISS's two-person crew configuration, spending nearly four hours outside the vehicle. Although the EVA was cut short due to a cooling problem in Kaleri's suit, the crew completed several payload activities for the European Space Agency (ESA), the Japan Aerospace and Exploration Agency (JAXA) and Russia. For ESA, the crew deployed on the outside of the Zvezda service module the Matryoshka experiment, a human phantom torso designed to estimate radiation exposure of various organs and tissues. For JAXA, the crew retrieved one of two remaining panels of the Micro-Particles Capture (MPAC) and Space Environment and Exposure Device (SEED) experiments mounted on Zvezda's exterior. The MPAC experiment captures micrometeoroids and other small particles while the SEED experiment exposes various materials to the space environment over long periods. The crew also retrieved and replaced samples for the Russian SKK materials exposure experiment on the Pirs docking compartment. Unfortunately, due to the shortened EVA duration, they were unable to replace another SKK panel and retrieve and replace panels from the Kromka thruster plume collection experiment. Those EVA tasks will be rescheduled, possibly during Expedition 9.



MPAC and SEEDS, attached payloads.

In the weeks leading up to the EVA, the crew was busy preparing for the spacewalk and research time was rather limited. However, during the remainder of the Expedition, the crew conducted a robust research program, including several new investigations. In the Advanced Diagnostic Ultrasound in Microgravity (ADUM) investigation (see separate article), Foale conducted an ultrasound exam on Kaleri to help develop strategies for diagnostic telemedicine both in space and on Earth. In the Journals investigation, Foale's onboard journal entries will be studied to help design equipment and procedures to allow astronauts to cope best with long-duration spaceflight. The Miscible Fluids in Microgravity (MFMG) investigation used honey and water to determine whether in microgravity miscible fluids exhibit the same transient phenomena as immiscible fluids.

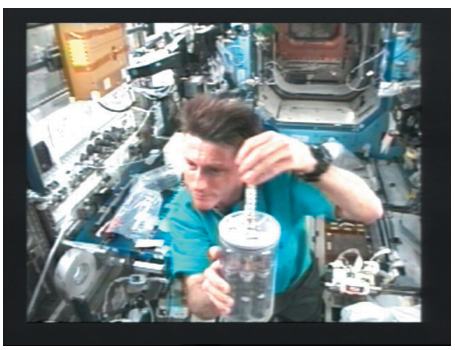
Among experiments continuing from earlier expeditions, Foale and Kaleri completed the Renal Stone experiment evaluating a countermeasure against kidney stones, the Foot experiment studying muscle forces used in space during daily activities, and the Interactions experiment studying interactions between the crew members as well as between the crew and ground control; continued photography as part of the Crew Earth Observation investigation, completed the Hand Posture Analyzer study of hand strength; supported a session of the EarthKAM education payload; processed five Pore Formation and Mobility Investigation (PFMI) samples in the Lab's microgravtiy sciences glovebox (MSG), performed several sessions of the Cellular Biotechnology Operations Support System-Fluid Dynamics Investigation (CBOSS-FDI) to help future cell culturing experiments; and conducted two beacon-to-beacon tests for the Synchronized Position

on 8 Research

Hold, Engage, Reorient, Experimental Satellites (SPHERES) experiment.

On January 31, 2004, the 13Progress (13P) vehicle docked with ISS, carrying, among other items, 13 kg of U.S. research hardware. One of these payloads, called Yeast-GAP since the experiment studies gene expression in yeast cells contained in a group activation pack apparatus, was activated shortly after its arrival and completed successfully within two days. Another experiment delivered by 13Progress, the Binary Colloidal Alloy Test-3 (BCAT-3), was initiated by Foale on March 29 and has been proceeding well.

The 13P vehicle delivered a Japanese protein crystallization experiment in the ESA-built Grenada Crystallization Facility (GCF). This was the third such collaboration between Japan and Russia, and this time there are also ESA-provided samples in the chamber. This was the second time that the GCF was placed in the NASA-provided Commercial Generic Bioprocessing Apparatus (CGBA), which provides thermal conditioning for the samples to improve the science yield. The GCF-3 was returned in the 7Soyuz vehicle with the Expedition 8 crew in late April.



Yeast-GAP is activated by Commander Foale.

As part of a joint NASA/ESA agreement, Foale installed and activated the ESA Protein Crystal Growth Monitoring by Digital Holographic Interferometry on ISS (PromISS) experiment in the MSG. Shorter runs of the experiment had been conducted during the Belgian and Spanish Soyuz "taxi" missions, but this 30-day session was, of necessity, conducted during the expedition.

Following their return to Earth, Foale and Kaleri are continuing their participation in the research program by conducting postflight sessions of several investigations to monitor their recovery to 1-g conditions. Among these are Renal Stone, Interactions and Foot which had in-flight sessions; as well as the Subregional Bone experiment that studies changes in bone mineral density; Mobility that studies changes in postural control; Biopsy that studies changes in muscle mass, tone and strength; and Chromosome that examines the effects of ionizing radiation on chromosomes.

Expedition 9 got underway on April 19, 2004, with launch of the 8Soyuz spacecraft from Baikonur, Kazakhstan. The original Expedition 9 crew was Valery Tokarev and Bill McArthur, but a medical issue caused McArthur to be replaced by his backup Leroy Chiao. A few weeks later, it was decided that the crew of Russian Commander Gennadi Padalka and U.S. Flight Engineer and NASA Science Officer Mike Fincke, who have trained together for the past four years, would make the flight. Accompanying Padalka and Fincke was ESA Astronaut Andre Kuipers of the Netherlands, who spent eight days aboard ISS conducting experiments as part of the DELTA mission, commonly

Commander Gennadi Padalka flanked by Mike Fincke and Andre Kuipers arrived on 7Soyuz.

(See **Research***, page 11)*

INCREMENT 9 RESEARCH INVESTIGATIONS ON ISS

Acronym	Investigation Title	Principal Investigator
ADUM	Advanced Diagnostic Ultrasound in Microgravity	Scott Dulchavsky
Biopsy	Effect of Prolonged Spaceflight on Human Skeletal Muscle	Robert Fitts
Chromosome	Chromosomal Aberrations in Blood Lymphocytes	Gunther Obe
Interactions	Crew Member and Crew-Ground Interactions During ISS Missions	Nick Kanas
Journals	Behavioral Issues Associated with Isolation and Confinement:Review and Analysis of Astronaut Journals	Jack Stuster
Mobility	Mitigate Locomotor Dysfunction After Long-Duration Spaceflight	Jacob Bloomberg
CEO	Crew Earth Observations	Kamlesh Lulla
EarthKAM	Earth Knowledge Acquired by Middle School Students	Sally Ride
EPO	Education Payload Operations	Cynthia McArthur
MISSE	Materials on ISS Experiment	William Kinard
SNFM	Serial Network Flow Monitor	Carl Konkel
BCAT-3	Binary Colloidal Alloy Test-3	Dave Weitz
CBOSS-FDI	Cellular Biotechnology Operations Support System-Fluid Dynamics Investigation	Joshua Zimmerberg
CFE	Capillary Flow Experiment	Mark Weislogel
FMVM	Fluid Merging Viscosity Measurement	Edwin Ethridge
FOAM	Viscous Liquid Foam – Bulk Metallic Glass	William Johnson
MAMS	Microgravity Acceleration Measurement System	Richard DeLombard
SAMS	Space Acceleration Measurement System	Richard DeLombard
PCG-STES	Protein Crystal Growth-Single locker Thermal Enclosure System	Dan Carter
CGBA	Commercial Generic Bioprocessing Apparatus	Louis Stodieck

Payloads Operations

Increment 8

By George Norris

Increment 8 continues! Mike Foale and Alexander Kaleri continue to work hard to accomplish our payload requirements.

Early and mid-Increment runs of several experiments have been completed. The Hand Posture Analyzer, Foot and the Renal Stone experiments' first and second runs were completed, and there only remains the end of Increment requirements to accomplish.

Several Educational Payload Operations (EPO) activites, two sessions of the EarthKAM, as well as multiple health checks of the GASMAP have been completed. The Human Research Facility experiments, Journals and Interactions, are performed weekly. The Fluid Dynamics Investigation (FDI) has completed 5 Tissue Culture Modules (TCMs) with the remaining TCMs to be completed during Increment 9.

The Pore Formation in Microgravity Investigation (PFMI) experiment encountered problems during its first run, but was repaired by the on-orbit crew. Since then, two samples were successfully processed with more samples scheduled for future operations.

The PFMI hardware was removed from the microgravity sciences glovebox (MSG) to accommodate the PromISS3 experiment. The PromISS3 samples were launched on 13Progress (13P) and installed in the PromISS3 hardware. The research run continued for 30 days. The PFMI hardware was re-installed in MSG for future runs.

The Granada Crystallization Facility (GCF) was installed in the Commercial Generic Bioproessing Apparatus (CGBA) after the 13P docking. It will remain in CGBA until its return on 7Soyuz (7S).

The Yeast-GAP payload was also launched on 13P. The crew activated the Group Activation Packs (GAPs) and after the designated amount of run time deactivated them. Other payloads launched on 13P were pre-positioned for operations by the Increment 9 crew.

The initialization of the Binary Coloidal Alloy Test (BCAT)-3 experiment began during Increment 8. The first five photo sessions are scheduled in Increment 8 with one remaining session to occur in Increment 9 one month after initialization.

Increment 8 will come to a close with the launch and docking of 8S. After nine days of docked operations, the Increment 8 crew will return and leave the pay-load operations on-board the ISS in the capable hands of the Increment 9 crew.

Increment 9

By Lamar Stacy

Operations preparation for Increment 9 has been a challenge due to the changing launch schedule and payload manifests for the visiting Progress flights that will occur during the Increment and the lack of baselined resource allocations. During the On-orbit Operations Summary (OOS) Technical Information Meeting (TIM) in Moscow last December, the MSFC Payload Planners successfully scheduled 193 hours of crew time for U.S. payload activities in the first version of the Increment 9 OOS. An additional 47.5 hours of U.S. payload activities were identified as Task List items. However, this large amount of time did not satisfy the defined requirements for the current payload manifest that includes only legacy and 13P payloads. The Final OOS completed on March 19 during the TIM at JSC has 183 hours of crew time for U.S. payloads scheduled and 44 additional hours on the Task List. This compares well to the latest IDRD allocation of 193 hours.

Recent changes to the crew assignment for Increment 9 caused the removal of one payload (Foot) and extensive changes to the crew training plan. Several payload training sessions have been reduced to fit within the limited crew training time available and some were reduced to either a familiarization (Fam) session or a crew self-study. Training for the U.S. astronaut on the European Space Agency (ESA) Soyuz taxi mission payloads to be operated in the MSG was reduced to 30-minute Fam sessions. The MSG orbital replacement unit (ORU) replacement activity has been deleted due to recertification of the sensors for a 10-year lifetime. The Computer-based training will be completed and archived for possible future use. However, it is strongly recommend that hands-on crew training be scheduled for this complex if required in the future. The only ground MSG unit capable of supporting this level of training is located at MSFC. The remainder of the hands-on payload training for the crew was completed in February.

Crew procedures and other documentation required to support Increment 9 flight operations continue to progress on schedule for the planned April 19 launch of 8S. During the first week of February, a TIM was held with ESA and RSC-E participation to discuss the plans and operations for the Dutch Soyuz taxi mission. There will be two simulations of these international interfaces. The first simulation included the Dutch cosmonaut operating training hardware at JSC on February 19. The second simulation, in March, will use crew surrogates and focus more on management interfaces for off-nominal situations.

POIWG Changes

By Jay Onken

The face-to-face Payload Operations and Integration Working Group (POIWG) has always been a forum for Payload Developers and Payload Operations and Integration personnel to exchange information on operations processes, procedures, and philosophies. The POIWG has recently evolved to a three- to four- day meeting that is scheduled about one to two months before each increment, where one day is devoted to generic operations changes or refreshers that affect multiple increments. The other days are dedicated to increment-specific topics and round-table discussions for the PDs manifested to fly the increment that is about to launch. Another change that is in the works is for the POIWG to be the standard place where our Operations (OPs) TIM is offered for any

*(See **Payload Ops**, page 11)*

Ground Systems Corner

By Donna Sellers and
Jimmy Whitaker

Real-time payload mission operations support continues within the Payload Operations Integration Center (POIC). The POIC performed a successful database transition in December to ensure POIC compatibility with onboard Payload Executive Processor (PEP) R4 software changes. In addition, the annual facility maintenance power down of the POIC was scheduled and performed. Finally, a major contract change occurred in the POIC in January, where the previous Utilization and Mission Support (UMS) Lockheed Martin contract responsibility and personnel transitioned to the Space Mission Communications and Data Services (SMCDS) Huntsville Operations Support Center (HOSC) work package Colsa Corporation contract. Although all attempts were made to insure that these transitions happened without any potential customer service/support incidents, we welcome any feedback you might have regarding these events.

Operational certification of the Phase 1 ISS Downlink Enhancement Architecture (IDEA) was achieved on January 8, 2004. The Phase 1 IDEA system replaces the existing GE Americom Domestic Satellite (DOMSAT) service; which provides for the transport of the ISS-50 Mbps Ku-Band data stream from the tracking and data relay satellite (TDRS) System White Sands Complex (WSC) to the JSC Mission Control Center (MCC) and MSFC POIC. NASA worked with the GE Americom carrier to terminate the DOMSAT service on January 23, 2004. After extended offline parallel data flow testing and primary flight system usage within the MCC and POIC, the IDEA system has been able to exceed the operational performance of the existing DOMSAT service. Analysis performed during the month of December show the existing DOMSAT service provided for a real-time data transport of 99.321% as compared to an IDEA service performance of 99.991%. In addition, the IDEA service allows for initial acquisition of signal

Operational IDEA hardware during integrated testing at the POIC. Deployment and certification of each pair of racks at the designated site completed Phase 1.

approximately one to three seconds earlier than the existing DOMSAT; reduces the overall data latency for real-time telescience operations by at least 100 milliseconds; and significantly improves ground operations personnel data transport real-time monitoring and control capabilities. Thanks to the efforts of the multicenter IDEA team (design, development, testing and operations personnel at JSC, GSFC, WSC and MSFC), IDEA Phase 1 was completed in less than one year after initial authorization to proceed by the Space Station Program Control Board. The Phase 1 architecture, lays the groundwork for the IDEA Phase 2 architecture which will allow the ISS Ku-Band downlink to increase from 50 Mbps to 150 Mbps while reducing long-term operations and maintenance costs and providing a foundation for additional joint development and operational support efforts between the MCC and POIC.

Development activities within the Telescience Resource Kit (TReK) team continue with the release of a Windows XP compatible version of the TReK software on December 11, 2003. In addition, the TReK team delivered Release 2, Service Pack 5, which provides a TReK to payload rack checkout unit command interface capability to support payload ground integration and test activities. Finally, the TReK team continues development of Release 3, which provides an integrated mechanism for users to manage a hierarchical payload command environment across geographically distributed TReK systems. This capability is intended to help those teams that need to manage a shared onboard resource such as a facility class payload. The environment can be configured such that one individual can manage all of the command activities associated with that resource/payload. TReK Release 3 is planned to be operational in August 2004. However, several beta releases will be available before that time. The first beta release, termed "TReK Beta G," was initially released on January 29, 2004.

The operational POIC near real-time telemetry (NRT) servers were upgraded in December. These hardware upgrades, along with the associated software improvements recently delivered, have resulted in significant performance improvements in the retrieval time required to access recorded payload telemetry parameter data processed within the POIC (in most cases by an order of magnitude). Additional planned upgrades are in development, including the expansion of the NRT capability to span a two-year timeframe in support of POIC Cadre and payload customer operational and engineering analysis functions.

Finally, the next version of the Enhanced HOSC (Huntsville Operations Support Center) System (EHS) PC desktop software (Build 4) has entered into independent verification/validation. This release provides additional "native PC" capabilities for the POIC Cadre and payload users including: script generation (for development of automated ground procedures); display generation (this release supports text-based telemetry displays development); and display validation. The subsequent release (Build 4.1), which is in development, will complete the initial capabilities provided natively on the EPC desktop platform and will include: complete display generation capability (including graphical objects); bulk validation of user-developed products; and to other user-requested product enhancements.

Onboard Training for U.S. Payloads, Is It For You?

By Benjamin Murphy, Catherine Whitehead

Since November 2, 2000, there has been a continuously crewed outpost in space, the ISS. At this point in assembly, most of the crew's time on board is spent doing construction, maintenance, and daily "household" or systems tasks. The crew members are also responsible for our science experiments and their operations.

Since most of the on-orbit time is required for system tasks, the majority of training time is, of course, allocated to systems training.

Less training time for payloads requires us to develop alternatives to traditional ground training. To ensure payloads have sufficient training to achieve scientific goals, some Payload Developers (PDs) have developed onboard training (OBT) products. These OBTs are used to train the crew when little or no ground time is available. These lessons are also then available onorbit to refresh the crew about their ground training.

For most payloads, there has been sufficient time to train the crew about operations on the ground. However, since February 2003, payload ground training times for the crews have been more challenged. As payloads have been manifested very late in the process and fly to the ISS on the Russian vehicles, time allotted to each payload has decreased, causing payload training time to become an even more precious resource. Another challenge that has been faced is the process of performing all training requirements for both systems and payloads with only two crew members.

There are many types of media that can be used as OBT. Some examples are onboard computer based trainers (OCBTs), video/photo lessons, hardware simulators and models, and drills and practical exercises. Standards for each type of media have been developed or are currently under development.

The onboard Training Working Group (OBTWG) and the Courseware Development Working Group (CDWG) are responsible for developing these standards. Both the OBTWG and the CDWG are working groups of the International Training Control Board (ITCB), a group of International Partners and NASA representatives that serves as a control board for ISS payload and system training. These standards can be found in the ISS document: SSP50503, International Space Station On Board Training Media Requirements. Currently, only the section pertaining to OCBTs has been approved by the ITCB. The OBTWG has developed a template for developers to use when building CD-ROM-based OBT products.

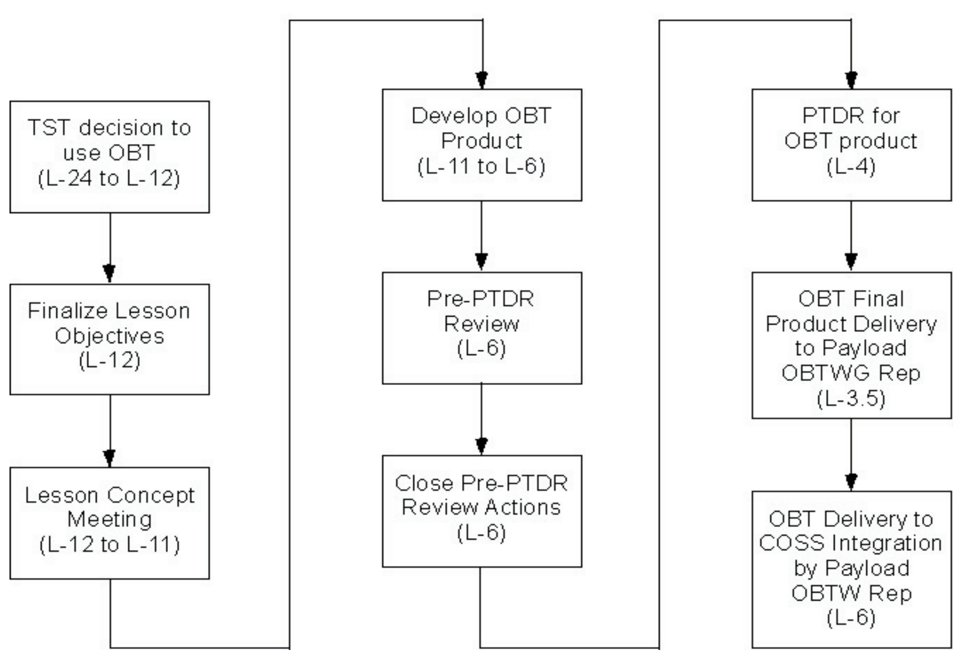
The Payload Operations Training Strategy Team (TST) determines the training possibilities for OBT. If an OBT is decided upon, section 4.3.4.3.1 of the Payload Training Implementation Plan (PTIP) SSP 58309 contains the details to guide you through the process. The PTIP describes in detail the points in the figure below that provide a road map of the OBT process.

It is important to note that the PD may request informal criterion referenced evaluations of the OBT product at any time during this process. PDs are encouraged to request these evaluations during the early design state to identify potential technical problems and to avoid possible negative impacts to schedules and budgets as the timelines near the critical integration dates. Frequent evaluation and coordination will ensure the final OBT product will meet the training objectives and the ISS integration requirements defined by the TST and the OBTWG. There will be a Payload Train-ing Dry Run (PTDR) prior to final delivery to the Payload OBTWG Representative for forwarding to be integrated for flight. At the PTDR, the OBT product will be assessed in terms of its overall per-formance, duration of planned utilization, and instructional effectiveness.

OBT can be used on the ISS for three purposes: refresher training, proficiency training, and just-in-time training. The most common types of OBT media currently used by PDs are OCBTs and video/photo lessons. Both of these lesson types are Web-based.

(*See* **On-board Training**, *page 11*)

OBT PRODUCT DEVELOPMENT



On-Board Training

(continued from page 10)

PAYLOAD OCBT

An OCBT lesson can incorporate both the science and the skill objectives that might be taught during a ground lesson. In turn, it might only contain one specific science skill or task the crew may need to perform.

The science information is often presented in a bulleted list, lecture-type format, like the information that would be presented in a ground training session.

The skills objectives covered in an OCBT are often presented using crew procedures developed for the skill. This method is very similar to the method that would be used in a ground lesson. These crew procedures can be supplemented with videos and pictures that help orient and teach the crew the proper methods to perform a required skill.

PAYLOAD VIDEO/PHOTO LESSONS

Video/photo lessons have been used in the past on procedures written during a mission to correct an unforeseen problem. Most video/photo lessons are skill intensive and do not include much science information.

An OCBT and a video/photo lesson are very similar in appearance and present their information in similar ways. This is to aid the crew in using all lessons since they are already familiar with the layout.

The major difference is text included in a video/photo lesson is used in the captioning of video segments. Science information is usually presented by the instructor. In some cases, the audio may be a narrator reading the actual procedures or a synopsis of the procedures.

OTHER PAYLOAD OBT TYPES

To date, only OCBT and video/photo lessons have been created for onboard payload training. However, there are some other OBT media types that could be used in the future.

A PD could create physical or simulator models. An example could be a virtual front panel of a payload. If the crew doesn't open the payload and only interfaces with the front panel, a virtual front panel could be created to allow the crew to simulate operations during a procedure walk-through before actual operations.

Another type of media that a PD may choose to use is onboard operational equipment. An example: supply the crew with an extra sample with which to walk through the procedures before processing the actual "science" sample.

Another type of media a PD may choose to use is teletraining. This media is not readily available because of minimized uplink and downlink capabilities during the assembly phase of ISS. As additional bandwidth becomes available, a PD can conference with the crew to instruct them as if the lesson was taught in a classroom. This method would be the least favorable for a scheduled training session but it would be better to support an in-flight maintenance procedure or other unforeseen training scenario.

CONCLUSION

As available time decreases on the ground for payload training, more OBT products will need to be developed to train the crew. Using the standards developed by the OBTWG, PDs can create products with controls and features already familiar to the crew. This decreases the amount of time needed to train the crew on orbit, and increases the crew's training productivity at the same time. Although OBT is not the best way to train the crew to operate payloads, it is the best viable source for training with limited ground time available and provides the PD with a backup to enable an opportunity to operate a pre-positioned payload.

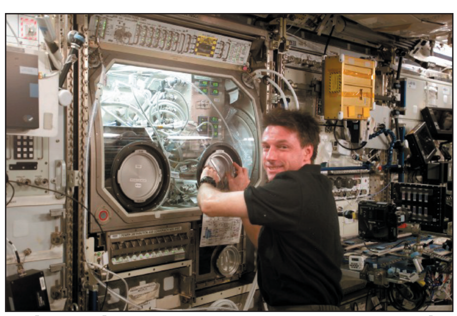
Payload Ops

(continued from Page 8)

payload developer with the emphasis on payload developers that are new to the Program. This TIM is essentially an operations workshop where some time is spent walking the PD through the entire Operations Integration process. It maps each area back to the Payload Integration Manager (PIM) Roadshow that the PD was given when first assigned a PIM. Some time is then set aside for each PD to give us an overview of his/her payload from a science and operations perspective. Any special splinter meetings that each PD may request can also be arranged while he/she is on-site.

Our experience has been that there is no substitute for face-to-face interaction. We are working hard to ensure that the right level of useful information is given to the PDs as early in the process as possible. We will be looking for feedback after each POIWG and Ops TIM to ensure that we are hitting the mark and making an efficient information exchange.

The next POIWG face-to-face meeting will be scheduled at MSFC, one to twomonths before the first flight of Increment 10. Hope to see you there!



Mike Foale monitoring an experiment in the versatile Microgravity Glovebox (MSG).

Research

(continued from Page 7)

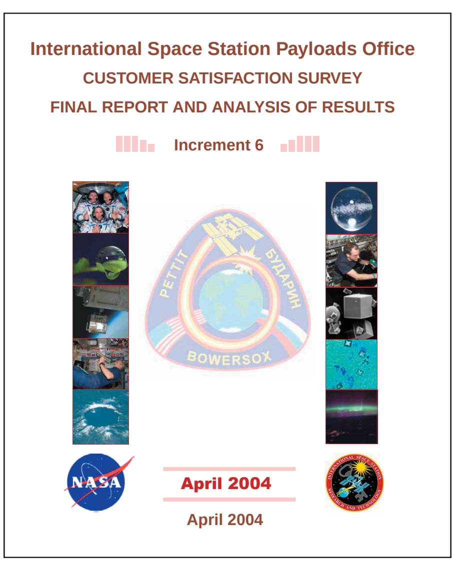
referred to as the Dutch Soyuz Mission. Two experiments, ARGES and HEAT, used the MSG in Destiny. Kuipers returned to Earth with Foale and Kaleri.

During their six-month stay on ISS, Padalka and Fincke are scheduled to conduct 20 U.S. investigations (see table), many of them continuations of those begun on earlier expeditions. The U.S. is working to launch new hardware items on the 15Progress vehicles in July. Although negotiations with Russia have not yet been finalized on the Progress manifests, it is hoped that the approximately 25 kg of U.S. research hardware on that flight will enhance the planned science.

Mick Culp, Editor
ISS Payloads News
mculp@ems.jsc.nasa.gov

The Payloads Office Survey Team has completed their analysis of the information gleaned from interviews with the Principal Investigators (PIs) and Payload Developers (PDs) who provided the research on ISS Increment 6. Even as Increment 7 interviews are under way, the documented results from Increment 6 are being used to assess and expand the process improvement initiative within the Payloads Office. The results, previewed here in a previous issue, are detailed in the document shown below. This document will be added to the Payload Developers Web Portal soon.

The results of the Increment 6 Survey show improvement over previous PI/PD satisfaction with integration and onboard operations. They also substantiate the improvement activities that are now in place; and it is anticipated that two or three new actions will be produced by OZ's Continual Improvement System.



International Space Station Payloads Office
CUSTOMER SATISFACTION SURVEY
FINAL REPORT AND ANALYSIS OF RESULTS
Increment 6

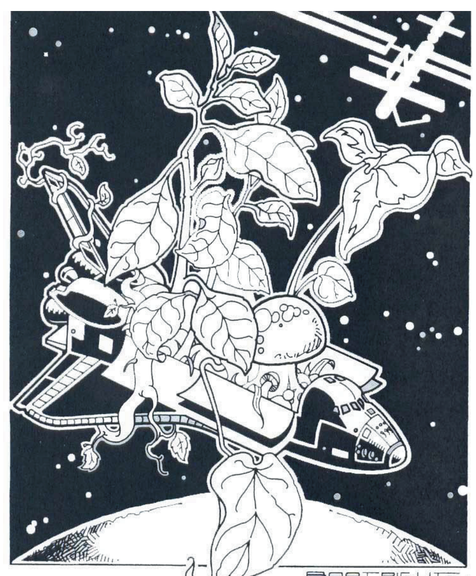
April 2004
April 2004

The Editor's Page

Softball and Mudbugs

By Mike Read

In the inaugural OZ quarterly office party, more than 125 employees and family members gathered April 2 at the Gilruth Center for a crawfish boil. All told, more than 240 lbs of crawfish, 100 ears of corn, 45 lbs of potatoes, 80 hamburgers, and 60 hotdogs, plus untold pounds of goodies from the dessert table, were consumed. In addition to the peel-n-eat activity that most folks engaged in (albeit some begrudgingly), there was also an impromptu softball game. From Jim Scheib's kids—all of them—to old guys like John Bartlett, everyone had a blast. Although we lost count of runs, and outs were less important than everyone getting a chance to bat, nobody got hurt, so it was considered a successful outing. It was a testament to the voraciousness of the pinch-the-tail-and-suck-the-head crowd that not a single crustacean was left unconsumed when the party finally broke up after 9:00 that night!



Ah, Houston—Atlantis. WE'D LIKE TO SPEAK TO THE PI ON THE 'ACCELERATED PLANT GROWTH IN MICRO-G' EXPERIMENT...